



# FUNCTIONAL PLANNING STUDY

## 16 AVENUE NE – DEERFOOT TRAIL TO BARLOW TRAIL

### BARLOW TRAIL / 16 AVENUE FREE FLOW INTERCHANGE CONCEPT DEVELOPMENT

FEBRUARY 2016

**DRAFT**

*Submitted By:*

**PARSONS**

## TABLE OF CONTENTS

1. Purpose .....	1
1.1 Methodology .....	1
1.2 Background .....	1
2. Option Generation .....	3
2.1 Initial Option Generation .....	3
2.2 Short Listed Options .....	4
3. Concept Assessment .....	5
3.1 Concept Assessment .....	5
3.2 Cost Estimates .....	5

# Functional Planning Study 16 Avenue NE – Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free Flow Interchange Concept Development, February 2016

## 1. PURPOSE

The purpose of this assignment is to examine other possible interchange configurations for the Barlow Trail interchange at 16 Avenue that permit all movements to operate under free flow conditions and be compatible with the other proposed connection configurations along 16 Avenue as per the Recommended Plan developed previously in 2014 / 2015.

High level costs estimates are to be prepared for a set of short listed free flow interchange concepts to illustrate the cost premium of providing free flow movements as compared to the 16 Avenue / Barlow Trail interchange configuration included in the Recommended Plan.

No recommendations will be made as to whether a free flow interchange configuration should be included as part of the Recommended Plan.

### 1.1 METHODOLOGY

To undertake this assignment, several sequential steps were completed to systematically develop possible free flow interchange concepts and then to assess those concepts that provide a potential alternative to the interchange configuration previously included as part of the Recommended Plan. The key steps included:

**Step 1:** This step involved generating various free flow interchange configurations for the Barlow Trail interchange along 16 Avenue. Any alternative concepts were developed to be compatible with the recommended interchange configurations at 19 Street and at Deerfoot Trail. A requirement of this assignment was to develop a “cloverleaf” interchange configuration in addition to any other free flow interchange configurations.

The configurations were developed at a single line sketch level of detail, showing the centerline of each carriage way and ramp.

**Step 2:** With a set of potential free flow interchange concepts developed, a review meeting with City of Calgary representatives was held to shorten the list to three practical alternatives. The review was based on a high level assessment of the ability of the concepts to accommodate the forecasted traffic demands efficiently along with an assessment of any potential constructability concerns.

Refinements to the free flow interchange concepts were made as deemed necessary to address any comments received during the review meeting.

**Step 3:** The short listed free flow interchange concepts were assessed in terms of potential advantages and disadvantages – as compared to the base interchange configuration included in the Recommended Plan. The

assessment of the three short listed free flow interchange concepts included a high level cost estimate, potential traffic operations issues, and the ability to provide connectivity through the interchange area for pedestrians and cyclists on the multi-use path system.

**Step 4:** Documentation involved preparing a brief report to describe the free flow interchange options being examined along with a summary of the assessment including the high level cost estimates.

### 1.2 BACKGROUND

The current interchange between 16 Avenue and Barlow Trail is configured as a “cloverleaf” with loop ramps provided in all four quadrants. However, this existing configuration presents significant operational and safety issues, especially with the short weaving sections between the consecutive loop ramps in all directions of travel. Continuous pedestrian and cycling facilities in the east west 16 Avenue corridor or in the north south Barlow Trail corridor are not provided due to the numerous conflicts with the various free flow movements within the interchange area.

Immediately upstream and downstream of the existing interchange, signalized intersections are located along Barlow Trail at 23 Avenue NE to the north and at 7 Avenue NE to the south. Barlow Trail is currently classified as a Major Street Divided whereas 16 Avenue is classified as a Skeletal Road.

The Recommended Plan stemming from the functional planning study is shown in *Figure 1.1*. In this exhibit, the proposed configuration of the interchange at Barlow Trail and 16 Avenue allows for free flow movements along 16 Avenue, however traffic control devices are located at the ramp terminals connecting to Barlow Trail. The two new signalized intersections along Barlow Trail at the ramp terminals are consistent with the functional classification of Barlow Trail as well as the roadway environment immediately north and south of the interchange.

Due to the close proximity of the 19 Street interchange to the Barlow Trail interchange, the configuration of the Barlow Trail interchange in the Recommended Plan accommodates the movements between 16 Avenue and 19 Street – to / from the east. By combining some of the movements between the two interchanges, significant infrastructure was avoided or minimized that would otherwise be required to eliminate the poor traffic operations that are typically associated with weaving traffic operations within an extremely short distance.

Functional Planning Study 16 Avenue NE  
 – Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
 Flow Interchange Concept Development, February 2016

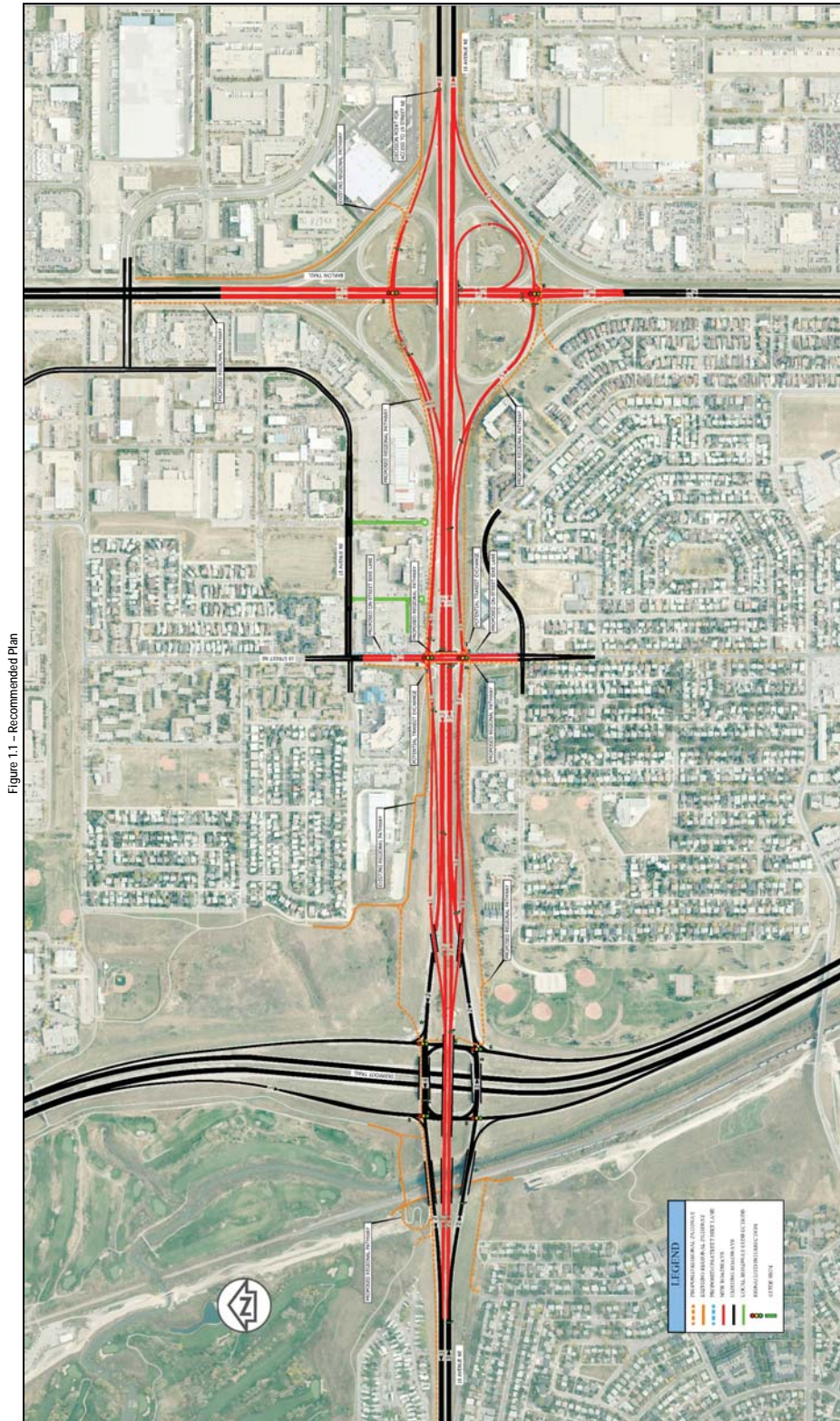


Figure 1.1 – Recommended Plan

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– Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
Flow Interchange Concept Development, February 2016

## 2. OPTION GENERATION

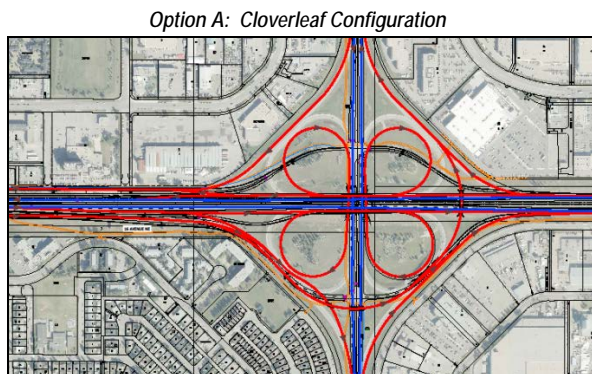
Several options were generated to allow the movements between 16 Avenue and Barlow Trail to operate under free flow conditions. As such, only merge and diverge operations are to be provided at the ramp terminals as opposed to the provision of a traffic control device such as a signalized intersection.

### 2.1 INITIAL OPTION GENERATION

A total of six options were generated and these are briefly described below:

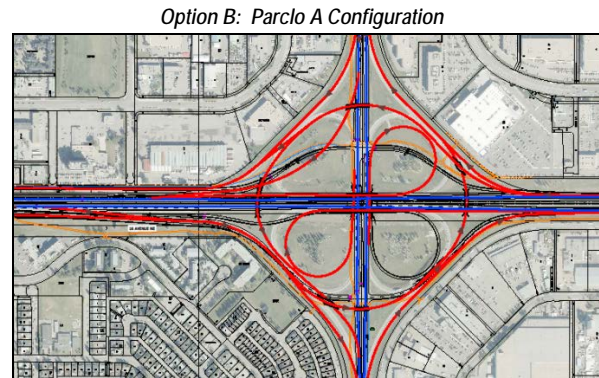
#### Option A: Cloverleaf Configuration

This option is similar to the existing configuration where free flow loop ramps are located in all four quadrants. However in this option, separate weaving lanes between the successive loop ramps have been added along 16 Avenue in both directions of travel to minimize the impacts to traffic operations in the through lanes. No separate weaving lanes were provided along Barlow Trail. To accommodate the 19 Street eastbound movement to 16 Avenue eastbound and Barlow Trail northbound, a single lane elevated directional ramp was provided.



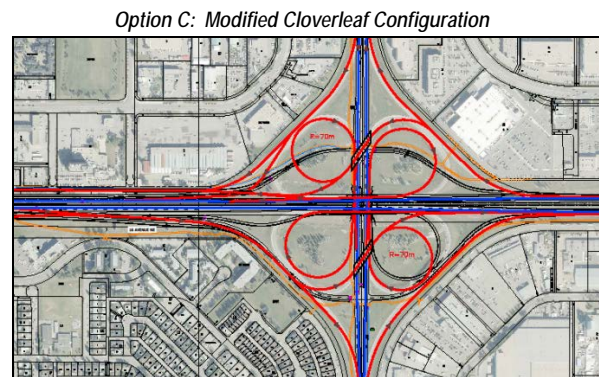
#### Option B: Parclo A Configuration

In this option, free flow loop ramps are provided in the northeast and southwest quadrants to accommodate the northbound to westbound movement and the southbound to eastbound movement. Single lane directional ramps are provided for the remaining movements including elevated ramps for the 19 Street movements to 16 Avenue eastbound and Barlow Trail northbound.



#### Option C: Modified Cloverleaf Configuration

This option represents a modification of the cloverleaf configuration to avoid the need for physically separated weaving lanes between the successive loop ramps along 16 Avenue. Similar to the Parclo A configuration, free flow loop ramps are provided in the northeast and southwest quadrants. However, to accommodate the westbound to southbound and the eastbound to northbound movements, separate directional ramps are provided with loop ramp connections to Barlow Trail. These separate ramps also accommodate the eastbound movements from 19 Street to 16 Avenue and the Barlow Trail northbound as well as from 16 Avenue westbound to 19 Street.

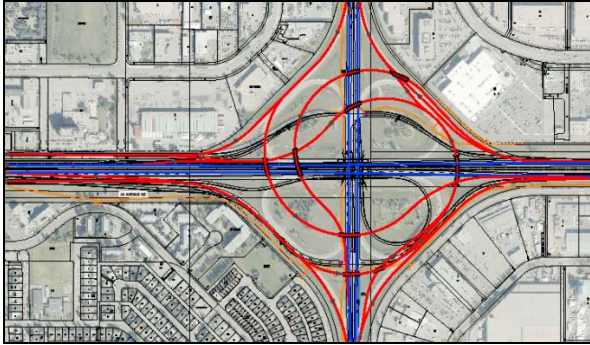


#### Option D: Directional Interchange Configuration

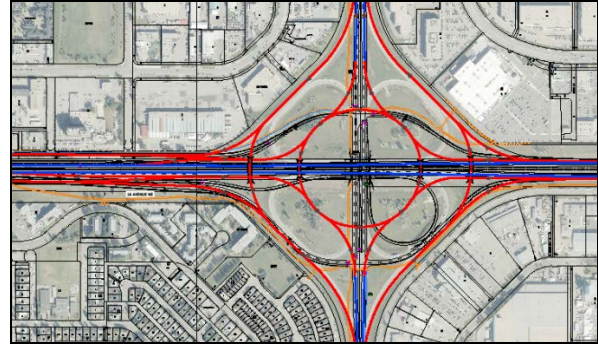
Single lane directional ramps are provided for all movements in this free flow interchange configuration. The four primary elevated directional ramps accommodate the "left turn" movements between Barlow Trail and 16 Avenue, as well as the movements between 16 Avenue (east) and 19 Street. At least nine new structures are required to maintain the free flow connectivity.

Functional Planning Study 16 Avenue NE  
– Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
Flow Interchange Concept Development, February 2016

*Option D: Directional Interchange Configuration*



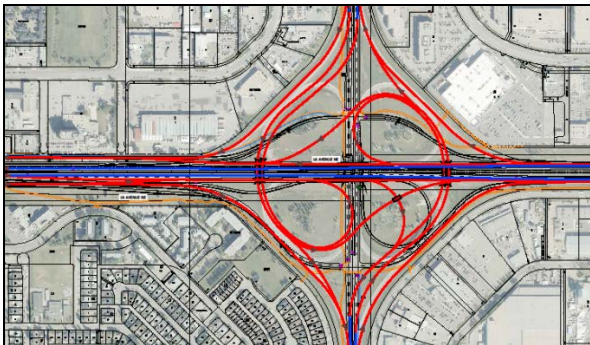
*Option F: Inside Rotary Interchange Configuration*



**Option E: Directional Interchange Configuration**

In this option, the Barlow Trail north and south through movements have been separated and provided via directional ramps. Single lane free flow loop ramps are provided for the 16 Avenue westbound to southbound movement as well as for the eastbound to northbound movement.

*Option E: Directional Interchange Configuration*



**Option F: Inside Rotary Interchange Configuration**

This option also relocates the north and south directions of Barlow Trail to directional ramps located on the outer limits of the interchange. A multi-lane (two lanes minimum) rotary located in the centre of the interchange provides the connectivity between 16 Avenue and Barlow Trail for all "left turn" movements.

**2.2 SHORT LISTED OPTIONS**

Based on the discussions at the review meeting with City of Calgary representatives, the list of potential free flow options was reduced to a short list of three practical options.

The rationale for supporting the retention of three options and the elimination of the other three options is summarized as follows:

**Option A: Cloverleaf Interchange Configuration**

This option is retained as the modifications address the weaving issues along 16 Avenue as compared to the existing conditions. Only two additional structures are required for the directional ramp as well as widening of the existing 16 Avenue overpass structures at Barlow Trail to accommodate the separate weaving lanes.

**Option B: Parclo B Interchange Configuration**

This option is retained as all the movements are accommodated in a reasonable manner through instinctive directional ramps and free flow loop ramps from Barlow Trail to 16 Avenue. A minimum of five new structures are required in addition to widening of the existing 16 Avenue overpass structures at Barlow Trail to accommodate the acceleration lanes from the loop ramps.

**Option C: Modified Cloverleaf Interchange Configuration**

This option is also retained as all the movements are easily accommodated with only two new structures along with widening of the existing 16 Avenue overpass structures at Barlow Trail to accommodate the acceleration lanes from the loop ramps. No significant weaving maneuvers are anticipated in this configuration

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## Option D: Directional Interchange Configuration

This option has been eliminated from further consideration as numerous (minimum of nine) new structures are required to accommodate the free flow directional ramps. There is also difficulty in accommodating the westbound 16 Avenue to 19 Street movement.

## Option E: Directional Interchange Configuration

This option has also been eliminated from further consideration given the numerous (five) additional structures required to accommodate the free flow movements. In addition, reconstruction of Barlow Trail is required along with demolition of the existing structures at 16 Avenue.

## Option F: Inside Rotary Interchange Configuration

This option is eliminated from further consideration due to the potential for significant weaving operations within the rotary that are anticipated to result in some level of congestion which would in turn negatively affect several movements. Reconstruction of Barlow Trail and demolition of the existing structures at 16 Avenue would also be required. Four new structures would be identified in this option.

For simplicity, the retained options have been renumbered as Concept 1 (Cloverleaf), Concept 2 (Parclo A), and Concept 3 (Modified Cloverleaf). These concepts are depicted in *Exhibits 2.1 – 2.3*.

## 3. CONCEPT ASSESSMENT

A brief assessment of each of the retained concepts is summarized in this section along with the high level cost estimates. The assessment includes the identification of several advantages and disadvantages compared to the base case (interchange configuration included in the Recommended Plan)

### 3.1 CONCEPT ASSESSMENT

#### Concept 1 – Cloverleaf Interchange Configuration

Advantages:

- Free flow operations for all movements

Disadvantages:

- Three additional structures (two overpasses and one underpass) to accommodate the directional ramp which facilitates the 19 Street to 16 Avenue eastbound and Barlow Trail northbound movements.

- Weaving operations between the successive loop ramps along 16 Avenue in both directions – although physically separated from the high speed through lanes.
- Retention of the weaving operations between the successive loop ramps along Barlow Trail in both directions.
- Lack of accommodation of east west multi-use pathway and north south multi-use pathway.

#### Concept 2 – Parclo B Interchange Configuration

Advantages:

- Free flow operations for all movements

Disadvantages:

- Six additional structures to accommodate the directional ramps including three for the 19 Street to 16 Avenue eastbound and Barlow Trail northbound movements.
- Lack of accommodation of east west multi-use pathway and north south multi-use pathway.

#### Concept 3 – Modified Cloverleaf Interchange Configuration

Advantages:

- Free flow operations for all movements

Disadvantages:

- Two additional structures to accommodate the directional ramps.
- Anticipated widening of the existing 16 Avenue overpass structure at Barlow Trail to accommodate the northbound to westbound loop ramp acceleration lane.
- Lack of accommodation of east west multi-use pathway and north south multi-use pathway.

### 3.2 COST ESTIMATES

High level construction costs were estimated for the three retained concepts based on unit costs per lane kilometre for the roadways (grading) and square metre of deck area for the structures.

Common costs from the construction cost estimate previously prepared in the functional planning study were included for all concepts such that the comparisons are consistent. These common costs included property acquisition costs, utility impacts, and other provisions. Contingency of 30% was applied to all of the above costs which is consistent with that used in the functional planning study.

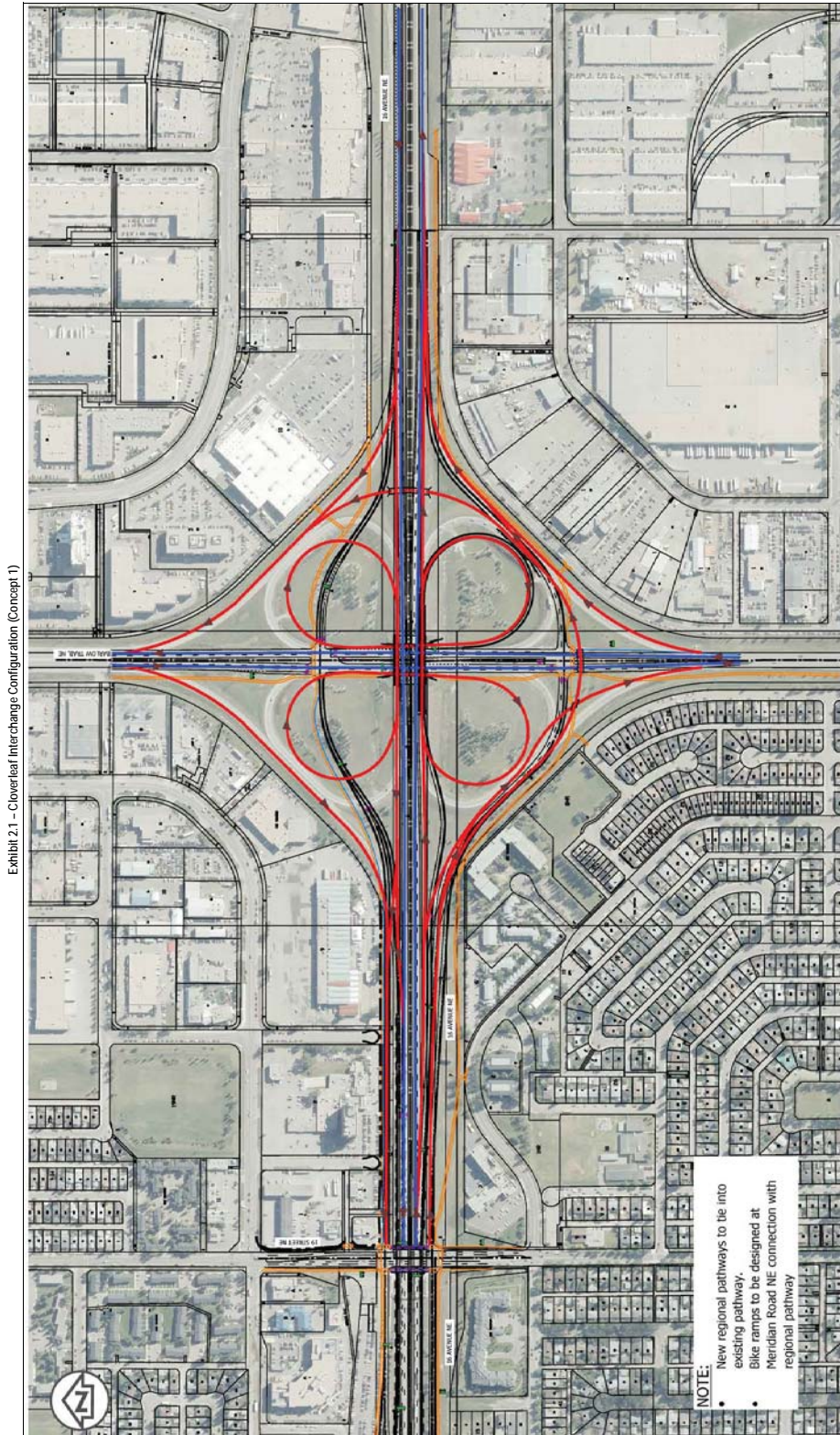
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 – Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
 Flow Interchange Concept Development, February 2016

For comparison purposes, a similar cost estimate was conducted for the base interchange configuration included in the Recommended Plan.

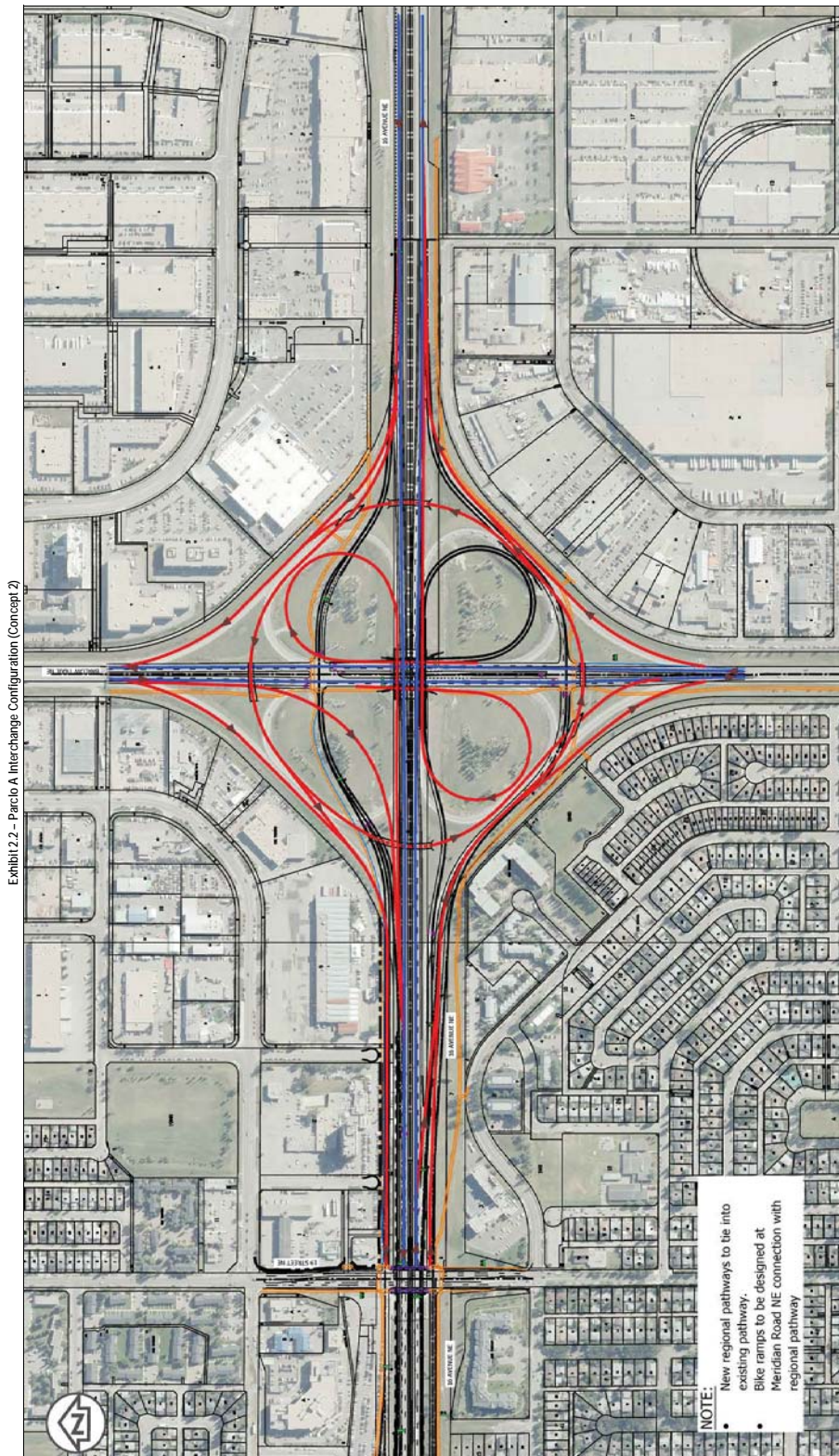
	Base	Concept 1	Concept 2	Concept 3
Roadway	\$21,000,000	\$32,000,000	\$32,000,000	\$31,000,000
Structures	\$2,000,000	\$13,000,000	\$23,000,000	\$18,000,000
Property	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
Utility Impacts	\$2,000,000	\$2,000,000	\$2,000,000	\$2,000,000
Other Provisions	\$3,000,000	\$3,000,000	\$3,000,000	\$3,000,000
Contingency	\$9,000,000	\$16,000,000	\$18,000,000	\$16,000,000
Total	\$36,000,000	\$66,000,000	\$78,000,000	\$69,000,000
Difference From Base		\$31,000,000	\$43,000,000	\$34,000,000



Functional Planning Study 16 Avenue NE  
– Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
Flow Interchange Concept Development, February 2016



Functional Planning Study 16 Avenue NE  
– Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
Flow Interchange Concept Development, February 2016



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– Deerfoot Trail to Barlow Trail: Barlow Trail/16 Avenue Free  
Flow Interchange Concept Development, February 2016

